

CLAIMS

1. A trocar obturator adapted to removable inserting into a cannula and subsequent forming a passageway in a patient's body cavity wall, including
 - a shaft,
 - an obturator handle disposed on the proximal end of said shaft,
 - a penetrating head disposed on the distal end of said shaft and comprising
 - a dilating sloping surface protruding distally beyond the distal end of said cannula,
 - an apex knife with at least one sharpened cutting edge adapted to carrying out an initial incision in a body cavity wall, at least partly protruding distally beyond the distal end of said dilating sloping surface during forming said passageway, and having the width which is less than maximal diameter of said penetrating head, therewith said dilating sloping surface participates in the subsequent dilation of said initial incision,
 - and a safety means designed for protecting said apex knife and at least partly located in said penetrating head,
 - said safety means comprising:
 - an apex knife shield designed for the protection of said apex knife, having the width substantially equal to the width of said apex knife, movably located on a shield base participating in the formation of shield guides, therewith said apex knife shield is adapted to actuating between a retracted position, in which said apex knife is open, and an extended position, in which said apex knife is closed and protected by said apex knife shield;
 - and a biasing spring for permitting the movement of said apex knife shield towards said retracted position in response to a proximally directed force applied to said apex knife shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex shield towards said extended position after piercing the patient's skin and before beginning the entrance of said dilating sloping surface into the patient's body cavity;
 - said apex knife, apex knife shield, shield base and biasing spring are constituents of a penetrating subassembly adapted for mounting on said shaft and there is a quickly acting connecting means allowing quick attachment / detachment of said penetrating subassembly to / from said shaft.
2. The trocar obturator of claim 1, wherein said dilating sloping surface is immovable in the shaft axial direction relative to said shaft during the trocar operation and said sharpened cutting edge at least partly protrudes distally beyond the distal end of said dilating sloping surface at the all stages of body cavity wall penetration, said apex knife has an apex knife body and said sharpened cutting edge is disposed on the distal end of said apex knife

- body, said apex knife body also serves as said shield base, therewith said shield guides are formed by the elements of said penetrating head body and said apex knife body.
3. The trocar obturator of claim 2, wherein said apex knife shield is made as a tubular shield.
 4. The trocar obturator of claim 2, wherein said apex knife body is made of a metal plate, and said apex knife shield is disposed from one of the sides of said apex knife body.
 5. The trocar obturator of claim 4, wherein said apex knife is sharpened and said apex knife shield is disposed from that side of said apex knife, from which said sharpened cutting edge is disposed, thereby eliminating a gap between said sharpened cutting edge and said apex knife shield and preventing the tissue fibers from introducing, jamming or engagement between said apex knife shield and said apex knife.
 6. The trocar obturator of claim 4, wherein there is an additional apex knife shield located from the opposite side of said apex knife with respect to said apex knife shield, therewith both said shields have a common base and are biased by common said biasing spring.
 7. The trocar obturator of claim 2, wherein said width of apex knife shield exceeds its thickness.
 8. The trocar obturator of claim 2, wherein said apex knife, apex knife shield, apex knife body and biasing spring are located in the limits of said penetrating head.
 9. The trocar obturator of claim 8, wherein said apex knife, apex knife shield, apex knife body and biasing spring form said penetrating subassembly, said quickly acting connecting means includes a penetrating head base inseparably connected to said shaft and a penetrating head cover between which said penetrating subassembly is mounted, there are a mounting means for holding these penetrating head constituents in the closed position and a setting guide means for convenient, simple and precise putting together said penetrating head constituents until they have been completely attached by said mounting means, therewith the distal portions of said penetrating head base and penetrating head cover form said dilating sloping surface.
 10. The trocar obturator of claim 9, wherein said setting guide means are made in the form of the projections and correspondent them recesses located on the put together contacting details thereby providing their precise mutual arrangement in the assembly process, and said mounting means include a clamping nut, which holds said penetrating head constituents in said closed position, and in their open position said clamping nut is freely disposed on said shaft.
 11. The trocar obturator of claim 10, wherein said penetrating head cover is pivotally mounted on said penetrating head base and in this way inseparably connected to said shaft.

12. The trocar obturator of claim 8, wherein said penetrating head is connected to said shaft by said quickly acting connecting means allowing quick attachment / detachment of said penetrating subassembly to / from said shaft along with said penetrating head as a whole.
13. The trocar obturator of claim 12, wherein said quickly acting connecting means is made as a collet connector.
14. The trocar obturator of claim 4, wherein there is at least one lateral knife protruding from said dilating sloping surface.
15. The trocar obturator of claim 14, wherein there are two said lateral knives, said lateral knives and apex knife body are made as a single detail, and said lateral knives protrude outward through slots in said dilating sloping surface.
16. The trocar obturator of claim 4, wherein said apex knife body, apex knife shield and biasing spring are made as a single detail.
17. The trocar obturator of claim 2, wherein said width of apex knife shield does not exceed five mm.
18. The trocar obturator of claim 15, having lateral safety means protecting said lateral knives.
19. The trocar obturator of claim 18, wherein said lateral safety means are designed for the personnel protection during the operations with said penetrating subassembly residing beyond said trocar obturator and include lateral shields which along with said apex knife shield are made as a single shield member, said shield member is configured so that in a shield member preset position, while said penetrating subassembly is beyond said trocar obturator, said lateral knives are protected with said lateral shields, and there is an installing means allowing the displacement of said apex knife body and said shield member relative to each other during installing said penetrating subassembly into said penetrating head so that, after connecting said penetrating subassembly to said penetrating head, said lateral knives are not protected, while said apex knife is protected both in said shield member preset position and in said shield member extended position, therewith said installing means includes a restricting element preventing said shield member from displacing distally during installing said penetrating subassembly and a transmitting element transmitting the distally directed axial movement of said quickly acting connecting means to said apex knife body during mounting said penetrating subassembly.
20. The trocar obturator of claim 1, wherein said apex knife shield is provided with a locking means designed for locking said apex knife shield in its extended position after piercing a patient's skin by said apex knife but before said dilating sloping surface has been entered a body cavity, said locking means have a lock position and an unlock position, comprises elements participating in locking / unlocking said apex knife shield including a distal

abutment surface movable along with said apex knife shield, a proximal abutment surface immovable in axial direction relative to said obturator handle, and is subdivided into a locking mechanism as well as a control means designed for unlocking said apex knife shield by user by means of transforming said locking means from said lock position to said unlock position.

21. The trocar obturator of claim 20, wherein said abutment surfaces are disposed in the limits of said penetrating head.
22. The trocar obturator of claim 21, wherein said locking mechanism includes a locking beam
 - capable of moving between an extreme distal position wherein said apex knife shield is unlocked and extreme proximal position wherein said locking beam is fixed by a fixation means and locks said apex knife shield in its said extended position, therewith said locking beam serves as a spacer between said abutment surfaces in said lock position eliminating the proximal axial displacement of said apex knife shield with respect to said shaft,
 - and capable of turning around the axis transverse relative to the axis of said shaft, therewith said locking beam turning is implemented by user through said control means to unlock said apex knife shield,
 - said locking beam is provided with a carriage in the form of two carriage members hosed in carriage guides and movable in the axial direction relative to said trocar obturator and said carriage members are connected with said locking beam by elastic links which allow said locking beam turning around transverse axis,
 - there are friction surfaces of said carriage members and said carriage guides which serve as said fixation means providing the fixation of said locking beam in said extreme distal position at the expense of friction force,
 - said locking beam is provided with a locking projection disposed at a locking beam distal end and interacting with an abutment member proximally located on said apex knife shield, therewith a distal surface of said abutment member and a proximal surface of said locking projection are sloping thereby allowing said apex knife shield unhampered transposition from said retracted position to said extended position elevating said locking projection due to turning said locking beam around said transverse axis, and a proximal surface of said abutment member, which is said distal abutment surface, and a distal surface of said locking projection are vertical thereby hampering the transposition of said apex knife shield from said extended position to said retracted position and locking said apex knife shield in said extended position.
23. The trocar obturator of claim 20, wherein said control means is disposed in the limits of said penetrating head.

24. The trocar obturator of claim 22, 23, wherein said control means is made as a knob disposed on a proximal end of said locking beam, accessible for user after withdrawing said trocar obturator from said cannula, and allowing unlocking said apex knife shield by user's finger effort pressing said knob and displacing it distally.
25. The trocar obturator of claim 24, wherein said knob is disposed within a recess in said penetrating head, distal and proximal walls of said recess serve as the limiters of the axial transposition of said knob thereby determining said extreme distal and proximal positions of said locking beam, and said recess proximal wall serves as said proximal abutment surface.
26. The trocar obturator of claim 23, wherein said locking mechanism is mounted on said apex knife body and is a constituent of said penetrating subassembly capable of emplacing into said penetrating head and removing therefrom along with said penetrating subassembly as its integral part.
27. The trocar obturator of claim 20, wherein said control means at least partly is disposed in said obturator handle.
28. The trocar obturator of claim 22, 27, wherein said control means is made as a remote means including a remote knob disposed in said obturator handle and accessible for user, a control spring and a transmitting bar whose proximal end is connected with said remote knob and whose distal face is adapted to the contact interaction with a proximal end of said locking beam and is configured to provide first said locking beam turning around said transverse axis and then transposing said locking beam from said extreme proximal position to said extreme distal position during transposing said transmitting bar distally by user effort applied to said remote knob in the distal direction to unlock said apex knife shield.
29. The trocar obturator of claim 20, wherein at least said proximal abutment surface is disposed at said obturator handle.
30. The trocar obturator of claim 2, wherein said biasing spring is characterized by an axial force permitting to return said apex knife shield from said retracted position into said extended position after patient's skin penetration, but before a peritoneum penetration, therewith during moving through the patient's soft tissue including the peritoneum said apex knife shield serves as a blunt penetrating tip.
31. The trocar obturator of claims 20, 30, wherein there is said locking means which locks said apex knife shield after returning said apex knife shield into said extended position thereby enhancing its operation reliability as a blunt penetrating tip.
32. The trocar obturator of claims 30, wherein a distal edge of said apex knife shield has a configuration facilitating its passing through a patient's tissues but sufficiently safe for the patient's organs located in its body cavity, for which purpose said distal edge is pointed,

therewith said configuration is formed with the surface converging to a line at obtuse angle and the all distal faces are made non-cutting.

33. The trocar obturator of claims 1, wherein the total area of said apex knife shield surfaces, which are non-parallel to a longitudinal axis of said trocar obturator and contacting with the tissue of the body cavity walls during stay of said apex knife shield in said retracted position, is considerably less than the area of said dilating sloping surface.
34. A method of forming a passageway in a patient's body cavity wall by a trocar, including a trocar obturator removably inserted into a cannula, said trocar obturator having:
- a dilating sloping surface protruding distally beyond a distal end of said cannula,
 - an apex knife, adapted to carrying out an initial incision in a body cavity wall, therewith said dilating sloping surface participates in subsequent dilating said initial incision;
 - a safety means for protecting said apex knife, comprising:
 - an apex knife shield designed for the protection of said apex knife and adapted to actuating between a retracted position, in which said apex knife is open, and an extended position, in which said apex knife is closed and protected by said apex knife shield,
 - and a biasing spring for permitting the movement of said apex shield towards said retracted position in response to a proximally directed force applied to said apex shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex shield towards said extended position after piercing a patient's skin and before beginning the entrance of said dilating sloping surface into the patient's body cavity,
 - said method comprises:
 - forming an initial incision in the patient's skin with said apex knife, therewith in doing so the skin displaces said apex knife shield in said retracted position,
 - continuation of forming said passageway in the patient's soft tissue, while said apex knife shield is displaced into said extended position by said biasing spring due to that the force of said biasing spring exceeds the resistance force of the patient's soft tissue, and during moving through the patient's soft tissue said apex knife shield begins to operate as a penetrating blunt tip so that a peritoneum is penetrated by it.
35. The method of claim 34, wherein said knife apex shield has locking means locking said apex knife shield in said extended position before said apex knife shield entering the body cavity, thereby enhancing the reliability of operating said apex knife shield as said penetrating blunt tip.
36. A trocar obturator adapted to removable inserting into a cannula and subsequent forming a passageway in a patient's body cavity wall, including
- a shaft,
 - an obturator handle disposed on the proximal end of said shaft,

- a penetrating head disposed on the distal end of said shaft and comprising
 - an apex knife, adapted to carrying out an initial incision in a body cavity wall
 - and a safety means for protecting said apex knife,
 - said safety means comprising:
 - an apex knife shield designed for the protection of said apex knife,
 - and a biasing spring for permitting the movement of said apex knife shield towards a retracted position in response to a proximally directed force applied to said apex shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex knife shield towards an extended position,
 - a locking means for locking said apex knife shield in said extended position including a control means designed for unlocking said apex knife shield by user,
 - said apex knife and apex knife shield are constituents of a penetrating subassembly adapted for mounting on said shaft and there is a quick attachment / detachment means allowing quick attachment / detachment of said penetrating subassembly to / from said shaft and said control means has a control member disposed in said obturator handle and accessible for the control on the side of said obturator handle, therewith attaching said penetrating subassembly to said shaft creates an operative contact of said control means with said knife apex shield and said control member is made for example as a knob.
37. A trocar obturator adapted to removable inserting into a cannula and subsequent forming a passageway in a patient's body cavity wall, including
- a shaft,
 - an obturator handle disposed on the proximal end of said shaft,
 - a penetrating head disposed on the distal end of said shaft and comprising
 - an apex knife, adapted to carrying out an initial incision in a body cavity wall
 - and a safety means for protecting said apex knife,
 - said safety means comprising:
 - an apex knife shield designed for the protection of said apex knife,
 - and a biasing spring for permitting the movement of said apex knife shield towards a retracted position in response to a proximally directed force applied to said apex shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex knife shield towards an extended position,
 - a locking means for locking said apex knife shield after its returning into said extended position,
 - said locking means subdivided into:
 - a locking mechanism including a distal abutment surface movable along with said apex knife shield and a proximal abutment surface immovable in axial direction relative to said

obturator handle in the operation process, therewith said abutment surfaces are disposed in the limits of said penetrating head,

- a control means designed for unlocking said apex knife shield by user.
38. The trocar obturator of claim 37, wherein said control means are disposed in the limits of said penetrating head.
39. The trocar obturator of claim 38, wherein said apex knife and safety means including said locking means are constituents of a penetrating subassembly adapted for mounting on said shaft and there are a quickly acting connecting means allowing quick attachment / detachment of said penetrating subassembly to / from said shaft.
40. The trocar obturator of claims 39, wherein said penetrating subassembly along with said penetrating head form a single unit to be quick attached / detached to / from said shaft by said quickly acting connecting means made as a collet connector.
41. The trocar obturator of claim 39, wherein said locking mechanism includes:
- a locking beam capable of moving between an extreme distal position wherein said apex knife shield is unlocked and extreme proximal position wherein it serves as a spacer between said abutment surfaces in said lock position eliminating the proximal axial displacement of said apex knife shield with respect to said shaft,
 - control means is made as a knob disposed on a proximal end of said locking beam, accessible for user after withdrawing said trocar obturator from said cannula, and allowing unlocking said apex knife shield by user's finger effort pressing said knob and displacing it distally.
42. The trocar obturator of claim 37, wherein said control means having control member disposed in said obturator handle and accessible for user without withdrawing said trocar obturator from said cannula.
43. A trocar obturator adapted to removable inserting into a cannula and subsequent forming a passageway in a patient's body cavity wall, including
- a shaft,
 - an obturator handle disposed on the proximal end of said shaft,
 - a penetrating head disposed on the distal end of said shaft and comprising
 - an apex knife, adapted to carrying out an initial incision in a body cavity wall
 - and a safety means for protecting said apex knife,
 - said safety means comprising:
 - an apex knife shield designed for the protection of said apex knife,
 - and a biasing spring for permitting the movement of said apex knife shield towards a retracted position in response to a proximally directed force applied to said apex shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex knife shield towards an extended position,

- wherein said biasing spring is characterized by an axial force permitting after patient's skin penetration, but before a peritoneum penetration to return said apex knife shield from said retracted position into said extended position, therewith during moving through the patient's soft tissue including the peritoneum said apex knife shield serves as a blunt penetrating tip.
44. The trocar obturator of claims 43, wherein there is said locking means which locks said apex knife shield after returning said apex knife shield into said extended position thereby enhancing the reliability of its operation as said blunt penetrating tip.
45. The trocar obturator of claims 43, wherein a distal edge of said apex knife shield has a configuration facilitating its passing through a patient's tissues but sufficiently safe for the patient's organs located in its body cavity, for which purpose said distal edge is pointed, therewith said configuration is formed with the surface converging to a line at obtuse angle and the all distal faces are made non-cutting.